This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

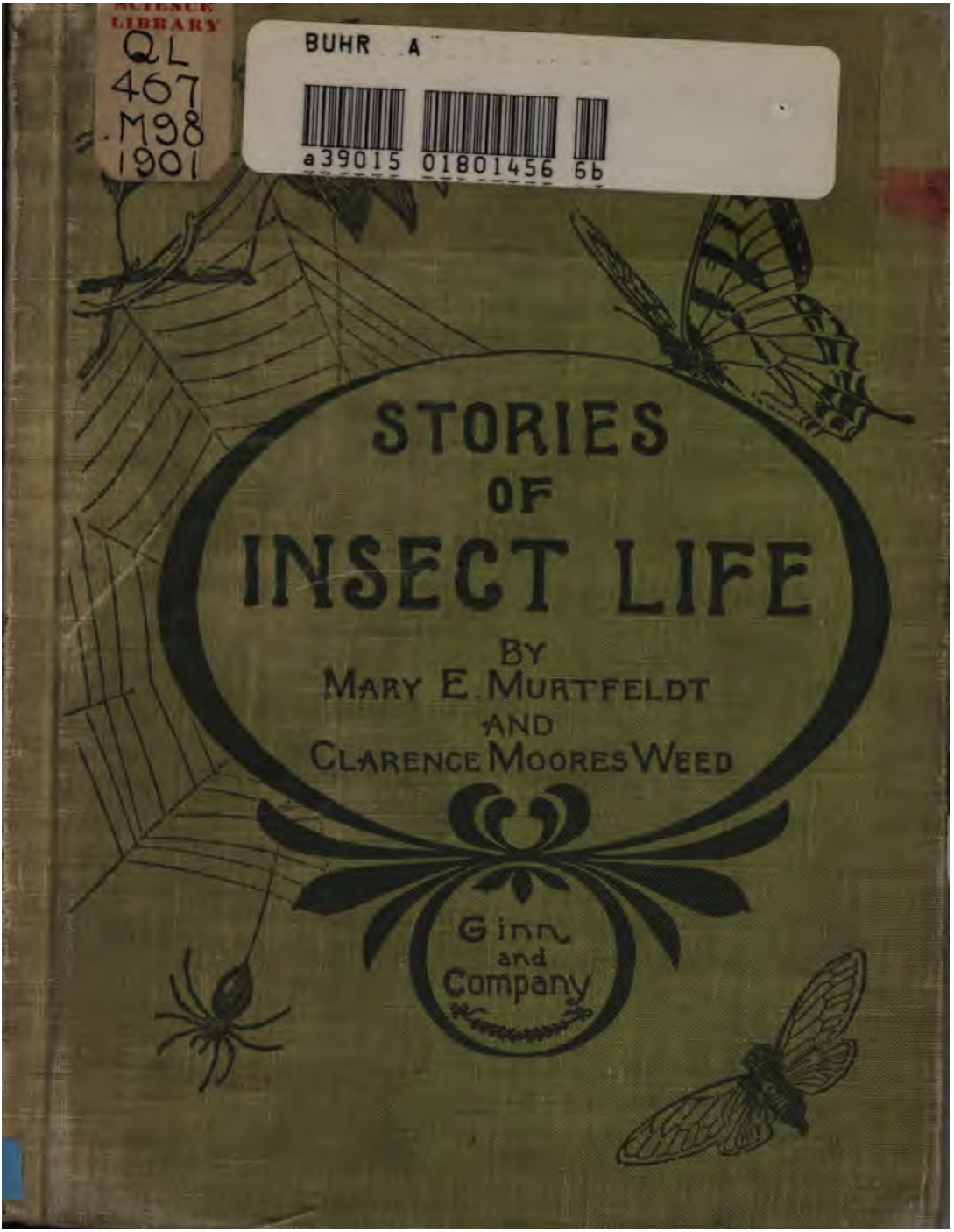
+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

SCIENCE LIBRARY
QL
467
.M98
1901

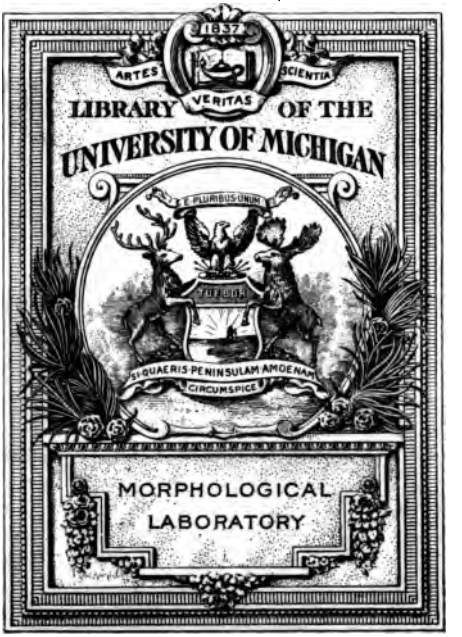
BUHR A
a39015 01801456 6b



STORIES OF INSECT LIFE

BY
MARY E. MURTFELDT
AND
CLARENCE MOORES WEED

Ginn and Company


1837
ARTES
VERITAS
SCIENTIA
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
E PLURIBUS UNUM
SI QUAERIS PENINSULAM AMOENAM
CIRCUMSPICE
MORPHOLOGICAL
LABORATORY

SCIENCE LIBRARY
GL
467
.M96
1901

STORIES

OF

INSECT LIFE

SECOND SERIES

SUMMER AND AUTUMN

BY

MARY E. MURTFELDT

AND

CLARENCE MOORES WEED

BOSTON, U.S.A.

GINN & COMPANY, PUBLISHERS

The Athenæum Press

1901

COPYRIGHT, 1899, BY
CLARENCE MOORES WEED

ALL RIGHTS RESERVED

CONTENTS.

		PAGE
	SUGGESTIONS TO THE TEACHER	v
I.	OUR INSECT MUSICIANS	1
II.	THE SONGS OF THE KATYDIDS	6
III.	THE SLUGS ON THE PEAR TREES	11
IV.	THE FIREFLY	14
V.	THE IO MOTHS	18
VI.	THE PROCESSIONARY CATERPILLARS	22
VII.	A QUEER LITTLE NURSERY	24
VIII.	THE FALL WEBWORM	30
IX.	THE WEBWORM TIGER	35
X.	THE PURSLANE CATERPILLAR	38
XI.	THE PURSLANE CATERPILLAR BECOMES A MOTH	42
XII.	AN INSECT MOTHER AND HER BROOD	46
XIII.	THE LIFE HISTORY OF A LADYBIRD BEETLE	49
XIV.	THE USEFULNESS OF LADYBIRDS	53
XV.	THE TOMATO WORMS	56
XVI.	THE PREYING MANTIS	63
XVII.	THE BAGWORM, OR BASKET WORM	69

SUGGESTIONS TO THE TEACHER.

In studying insects it is very desirable to be able to keep them under observation from day to day. For this purpose various sorts of "breeding cages" are commonly employed. A breeding cage is simply a closed vessel in which a caterpillar or other insect may be kept alive and fed, so that it will go through the cycle of its changes where it can be seen. A simple form of such a cage consists of a lantern globe or lamp chimney resting upon a wide, shallow dish, in which sand or earth to a depth of two or three inches has been placed. When it is to be used for large caterpillars a small glass vial nearly full of water is set down in the sand in the middle of the space, with the top of the vial projecting somewhat above the surface. In this vial a leaf or branch of the food plant is placed. The cage is now ready for the caterpillar, which will find its food kept fresh for two or three days by the water in the vial. Then a new leaf or branch may be exchanged for the old one. The open top of the lamp chimney is to be kept covered with a small piece of mosquito netting, held in place by a rubber band. For the lower dish a flowerpot or a flowerpot saucer serves the purpose very well.

Many forms of boxes may also be used for keeping insects under observation. An empty chalk box, with a piece of glass in place of the usual cover, does very well for some kinds of insects, though the box is likely to be spoiled if damp earth is

placed in the bottom. An ordinary glass fruit jar, with mosquito netting over the top, held in place by a rubber band, serves very well for rearing many insects, while for smaller leaf-eating caterpillars, glass tumblers or jelly glasses with perforated tops may be used to advantage.

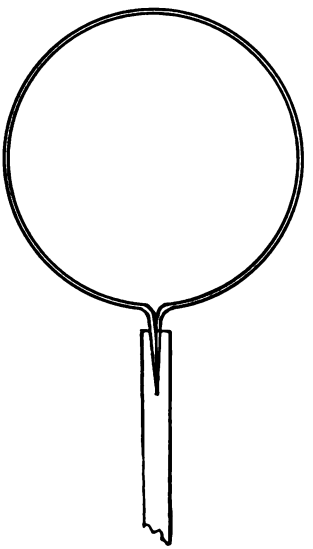


FIG. *A*. — Ring for Insect Net. (Diagrammatic.)

To collect many kinds of flying insects an insect net is desirable. This is easily made by forming a ring ten or twelve inches in diameter out of stiff wire, with the ends welded together as shown in Fig. *A*. The pointed end thus made is to be inserted in the end of a suitable handle — a broomstick serves the purpose very well, although it is a little too large around to use easily. Then a bag, about two feet deep, of mosquito netting, cheese cloth, or some similar material is to be attached to the ring of wire. If the net is to be used much it will pay to sew over the wire a strip of strong muslin, to which the lighter cloth is to be attached. This muslin in contact with the wire will last longer than the thinner cloth would, as this is the place where most of the wear comes.

Some form of a killing bottle is very desirable for any one who gives even slight attention to the habits of insects. For small specimens such a bottle as is shown in Fig. *B* is excellent. It consists of a good-sized vial fitted with a cork. In the

bottom are placed two or three small lumps of cyanide of potassium, a deadly *poison*, which must be handled with great care, so as not even to inhale any of the fumes; then cover the lumps with a little fine sawdust, after which turn in a little thick, freshly mixed plaster of Paris; this forms on top of the sawdust a layer that soon hardens and remains in place. As soon as the superfluous moisture has evaporated insert the cork, and the preparation of the killing bottle is finished. The fumes of the cyanide rise through the plaster of Paris, filling the space below the cork. When an insect is put in the bottle it is quickly killed.

FIG. *B.*
Small Cyanide Bottle.

Larger bottles for larger insects may be prepared in a similar way. Almost any wide-mouthed bottle will do for medium-sized specimens, while glass fruit jars may be brought into use for the largest butterflies and moths. Of course these bottles must be kept away from small children, who might remove the cork and inhale the fumes. Each should be labeled *Poison.*

It is very desirable that butterflies and moths should be preserved with the wings spread out. For this a "setting board" is needed; it is made of two thin strips of pine board about a foot long, nailed to end pieces, as shown in Fig. *C*, with a space of half an inch, more or less, between. A narrow strip of sheet cork is tacked on the underside of the boards so as to cover the space between them. When the moth is killed

it is pinned through the middle of the thorax, the pin is inserted in the cork below the groove, so that the body will fit between the boards, and the lower surface of the wings rests upon them. Then by means of long pins or needles in wooden handles the wings are to be brought into position so that the hind margins of the front wings are at right angles to the body, and held there until the narrow strips of cardboard are fastened in place by pins.

After the moths or butterflies are thus fastened to the setting boards the latter are to be put out of the dust in some warm, dry situation where, in the course of a week or ten days, they will dry out and harden to such an extent that the wings will remain in position after the insect is removed from the setting board.

A supply of insect pins, which are longer and better than ordinary pins, and of sheet cork is very desirable. These may be obtained, at small cost, of dealers in natural-history supplies in any of the larger cities. The insects may be kept in empty cigar boxes having a layer of cork in the bottom or in almost any form of tight case.

The teacher desiring fuller information upon methods of collecting and preserving insects will find Prof. J. H. Comstock's book *Insect Life* of great value. It also is full of suggestions regarding the study of living insects, which should always have the first place in school work. The aim of the teacher should be not to foster the collecting spirit so much as to develop the perceptive faculties in such a way that the pupil will not only notice the living things about him, but will be on the alert for the significance of their structure, their color, or their habits of life.

This little book is designed for use as a reading book which shall lead the pupil to fuller observation upon the insects about him. It is intended to be used during the latter part of summer and in the autumn as the companion volume is designed for use in spring and early summer. It is not essential that the articles be read consecutively, but it is highly desirable that the pupils actually see as many as possible of the insects discussed.

Nearly all of the illustrations in the book have been drawn especially for it by Mr. Joseph Bridgham. For the others, credit should be given as follows: Figs. 1–5 are from *Insects Injurious to Vegetation*, by Dr. T. W. Harris, the electrotypes having been obtained through the courtesy of Secretary William R. Sessions, of the Massachusetts State Board of Agriculture. Figs. 15, 20, 21, 33, and 34 are from the reports of the late Dr. C. V. Riley, electrotypes having been obtained through Mrs. Riley.

C. M. W.

STORIES OF INSECT LIFE.

OUR INSECT MUSICIANS.

THE tree-top concert troupe, of which Dame Nature is the manager, includes not only the birds, which are the celebrated singers, but a great orchestra of insects that do the instrumental parts. They are fitted out with the most ingenious little drums, violins, and castanets that you can imagine, and on these they play most skillfully, without ever taking lessons or spending time in practice.

In this country these insect musicians have a "season" of six or eight weeks during the long, hot days and still nights of mid-summer. Nature makes great preparations for their comfort and enjoyment. Their "green rooms" are every year freshly curtained and decorated and a continual feast is spread of the food most agreeable to their taste. "And which are the musical insects?" do you ask?

Well, in the first place, there are so many insects that have the power of producing sounds that it would make the list too long to mention every one. We will therefore include among our true musicians only those that have some especial apparatus for the purpose, and that

make a business of playing at certain hours of the day or night.

This will leave out all the bees, wasps, and flies, most of the beetles and grasshoppers, and even the mosquito whose "song" so exasperatingly informs us of her bloodthirsty intentions before she has a chance to stab us with her tiny lancets.

All these insects produce their "hummings" and "buzzings" and "whirrings" by the mere act of flight, and, though they add a very fine tone to Nature's harmony, we will not here consider them as members of our "Band."

Among our greatest performers are the harvest flies, or cicadas, some of the true grasshoppers, and all of the katydids, black crickets, and tree crickets. It must be remembered that only the males are provided with instruments and are supposed to play for the purpose of calling up their mates. But as they continue their solos and choruses for hours and seem to pay no attention to the members of their family which may come to listen, we may conclude that they play for the pure enjoyment of it.

One or two of the lady katydids sometimes make a sharp chirping sound by a sudden jerk of the wings, but they are the exceptions to the rule.

It has always been a great puzzle to find out where the ears of insects were located, and so far this has been done only in the case of certain grasshoppers, which have ear-like organs on the joint of the hind part of the body next the thorax, and in the katydids and some of their relations,

which have their ears on their front legs! Nothing that would seem to serve as organs of hearing has yet been found on the noisy harvest flies, nor on the squeaking beetles. It is, however, only reasonable to suppose that all insects, having an especial apparatus for producing sounds, have also some means for hearing them.

Every one will agree that in the summer concerts the "leading rôle," as musical people would say, is taken by

FIG. 1. — Harvest Fly, or Cicada.

the harvest fly, or dog-day fly, or annual cicada (Fig. 1). This insect is well known in almost all parts of the United States. It makes its appearance every summer. It is one of the largest American insects of its family, another being its singular cousin, the seventeen-year or thirteen-year cicada, commonly, but incorrectly, called a "locust."

There are two broods of the common harvest fly, one of which appears one year and the other the next, because it is said to be two years in getting its growth. This period is passed underground, feeding on the tender roots

of trees and shrubs (Fig. 2). When full-grown it tunnels its way upward toward the light and air, but stops just below the surface to change its form for one better suited to crawling on the ground and climbing trees. This is its pupa stage. It has now a hard, light brown shell with strong, spiny legs, large eyes, and wing pads. In this form it comes out of the ground and runs as fast as it can to the nearest tree, up which it scrambles to a height of several feet. Here it attaches itself firmly to the bark by its spiny legs and claws and is ready for its second change of form.

FIG. 2. — The Young of the Harvest Fly, feeding on a Root Underground.

This takes place in a few hours. The pupa shell opens on the back, and the perfect fly draws itself out. It is very soft and pale in color at first and the wings are short and limp. As soon as its body hardens a little it climbs up into the tree and hides among the leaves until its wings spread and stiffen and it is able to fly. The empty pupa shells are left clinging to the tree, and many of these are to be seen every summer in orchards and groves.

The perfect insect is more than two inches long and quite stout. The head is short and broad with a large

round eye on each side. It has short, bristle-shaped antennæ and a sharp, strong beak doubled under its chin. The colors are black and green, and on the sides and underneath it has a chalky appearance.

The drums are on the under side, covered by little rounded flaps that are hinged to the body on one edge. Over the hollows are stretched convex pieces of membrane gathered into fine plaits. These form the drum heads and are played upon, not by sticks, but by strong muscles or cords underneath, which are loosened and tightened with great rapidity, producing a shrill rattling sound that begins rather slowly but gets louder and faster in its vibrations, until it is almost deafening when close at hand, and finally dies away in a slow, dragging "whirr," as though the performer were tired out. But after a minute's rest he begins again with great energy. These performances take place usually in the afternoon and are continued into the twilight hours, but during the night the insects rest or amuse themselves quietly.

The seventeen-year or thirteen-year cicadas appear in immense numbers at their appointed times, and the woods and orchards during these "locust years," as they are called, ring with the long-drawn-out "*Pha-a-a-a-rho*," as the sound has been translated, by those who at first thought these insects to be the same as the "locusts" which plagued the wicked king of Egypt in early biblical times.

THE SONGS OF THE KATYDIDS.

THE prettiest and most interesting of musical insects are the katydids and their near relatives. The true katydids live in trees or on tall shrubbery and are more frequently heard than seen. There is quite a family of them, each differing from the others in form and having its own peculiar tune.

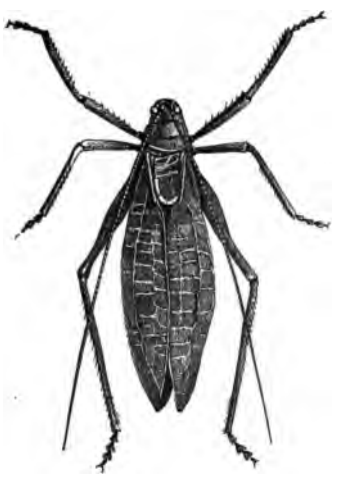


FIG. 3. — The Broad-winged Katydid.

They are very active and graceful insects, of a deep green color, and in the texture and veinings of the wings imitate the leaves among which they dwell. The head in several species is shaped and set on like that of a horse, and they have a most wise and dignified expression. They all have very long, thread-like antennæ, of which they take the utmost care. The legs are quite long, especially the hinder pair, and they are great jumpers. The musical apparatus is on the back, at the bases of the wings. It consists of two triangular, overlapping plates of strong, clear membrane, surrounded by a raised horny border

with some cross ridges of the same substance. When the upper wings are partly lifted and slowly opened and closed, these ridges grate upon one another and produce the distinct rattling sounds by which these insects are known.

The "head of the family" is the broad-winged katydid — the only one whose upper wings entirely cover the under pair and the body. This hatches in the spring, from eggs that had been crowded into the rough bark of trees, and grows for about two months before it gets its wings.

This is the species that, all through the summer nights, continues to tell us either that Katy "did" or that she "didn't," but never reveals to us who "Katy" was, or what remarkable thing she did that should be so continually asserted and contradicted. The poets, it is true, would have us believe that they know all about it, and have told the story in many ways in very musical verses, but we still have our doubts as to whether the katydids really favored them more than they have other people.

The next species to attract attention is the angular-winged katydid. This is a longer and more slender insect, which takes its name from the upper outline of its wings. It is the eggs of this species that are so often found bordering the margins of leaves or arranged, one overlapping the other in rows, on slender twigs and on strings and wires, sometimes even indoors. The note of this insect is simply a clear rattle, which has been com-

pared to the sound made by drawing a stiff quill slowly across a coarse file, or to some sorts of baby's rattle boxes.

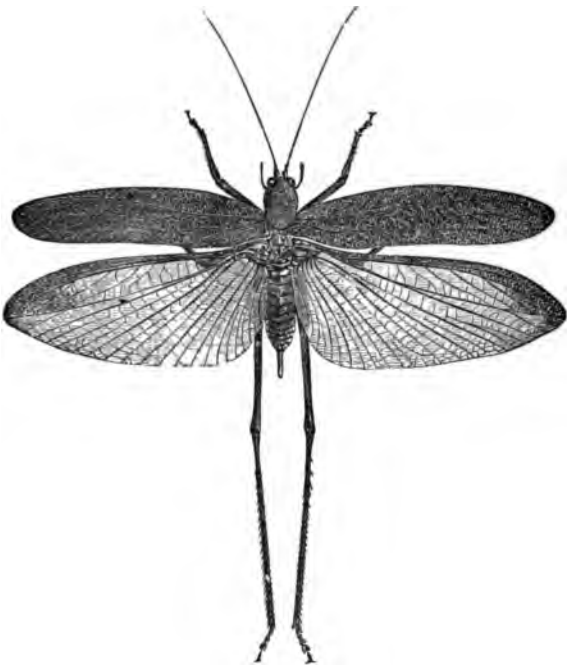


FIG. 4. — The Narrow-winged Katydid with Wings Expanded.

Another member of this tree-top family is the narrow-winged katydid — a pretty little creature, only about one-half the size of the two just described. Before this species gets its wings, it is frequently found on bushes and low plants. This is accounted for by the fact that it hatches on the ground from eggs which its mother had the fall

before pushed into the edges of oak and other thick leaves, between the upper and under skins. It is the most gaily dressed of all the young hoppers, having its velvety green coat ornamented with bands and dots of red and yellow. Its wings also, after it is grown, show some rainbow-like colors in certain lights.

The note of the male is a soft little call, like *zeep, zeep, zeep,* to which its mate responds with a cheerful "chirp," by suddenly extending her wings as if for flight.

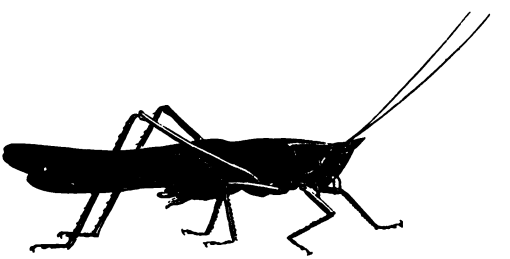


FIG. 5. — The Cone-head Katydid.

Still another very noisy insect is the cone-head, represented in Fig. 5. It quite closely resembles the angular-winged species, except that it is more slender, with straight wings, and has the head pointed on top. It makes a long-continued, shrill whirring that when heard close at hand is almost ear-splitting.

These are the principal performers in the nightly concerts, but their music is accompanied by the chirpings of the black crickets, the soft murmurings of those shy and singular insects, the mole crickets, and by the high notes of the delicate little tree crickets.

Besides the "musicians" mentioned, there are a considerable number of their more or less distant cousins, that

give very lively matinée performances during sunny afternoons in the fields and meadows.

Among these we find, in addition to several of the long-horned grasshoppers, which are smaller in size, but otherwise much like those that live in trees, some short-horned grasshoppers, the true "locusts," that are most accomplished fiddlers. They sit upon tall grass stalks and play, first with one stout, roughened hind leg and then with the other, upon the ridged surface of the upper wings, exactly as a violinist draws his bow across the strings of his instrument. There are quite a number of these, but we cannot now describe each separately.

Any observing boy or girl can make their acquaintance, without an introduction, by visiting them in their homes and approaching them softly, so as not to interrupt their solos.

No insects afford more interesting subjects for study than these musical species.

The katydids, especially, are very friendly and confiding, and will sit upon one's finger while dressing their antennæ or polishing their feet and wings, and will even nibble a bit of bread or apple with great relish if it is offered to them. When confined in an insect cage of glass and wire cloth, they become perfectly tame, and if well supplied with fresh leaves for food, will go through all their performances with as much energy and pleasure as though they were free.

THE SLUGS ON THE PEAR TREES.

DURING the summer months one may frequently find the leaves of pear, cherry, and plum trees partially eaten

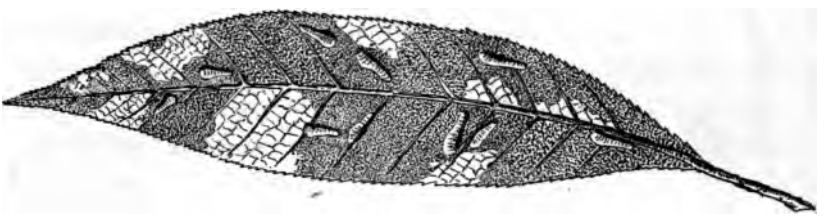


FIG. 6. — The Slugs on the Pear Leaf.

by a greenish black, somewhat slimy, slug-like worm. This is the insect called the pear or cherry slug. It hatches from eggs laid in the leaf during June by a four-winged black fly belonging to the family of sawflies.

FIG. 7. — The Parent Fly which lays the Eggs. Magnified.

This little fly, the general form of which is shown in Fig. 7, lights upon the upper surface of the leaf and runs about a moment. Then she crawls on to the under surface. Here she chooses a place, and then inserts the saw-like egg-depositor at the end of the hind part of her body

into the leaf, in such a way as to cut loose the substance of the leaf from the skin of the upper side. In this way a little cell is formed, into which the fly deposits an egg. Then she goes to another leaf to lay another egg.

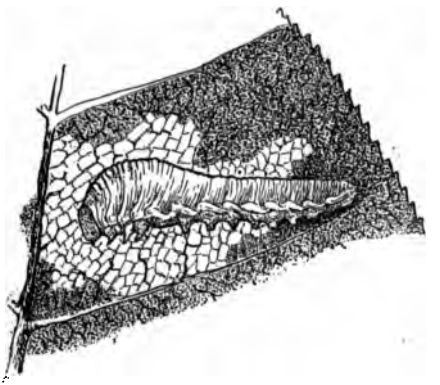


FIG. 8. — The Pear Slug. Side view. Magnified.

The little pocket or cell in which the egg was laid becomes brownish within a few days, but the egg remains in position for about two weeks. Then there hatches from it a tiny larva, which eats its way out to the upper surface of the leaf, making a crescent-like cut.

When the young larva first comes out of its cell it is whitish with a brown head. The skin is dry and bright, but very soon there comes from the skin a sticky, slimy liquid of an olive color, which makes the little creature look like one of the slugs you may easily find under boards lying

FIG. 9. — The Pear Slug. Back view. Magnified.

on damp ground. These slugs under boards are a kind of snail which have no shell.

This resemblance to the true slugs, due to the slimy liquid, has given these pear-leaf insects the name of pear slug. The body is larger in front than behind, and there are many legs on its under surface.

The young slugs at once begin to eat the green upper surface of the leaf, leaving the veins and lower surface. They moult, or cast their skins, about once a week and become full-grown in this larva state in about four weeks. During this period of growth they increase considerably in size, but do not change much in their general appearance until the last moult. At this time, however, they cast off the slimy skin for a clean coat of orange yellow.

After this moult the insect takes no more food, but crawls to the ground, where it burrows into the soil about an inch. Here it forms an earthen cell, in which it changes to the pupa state. About two weeks after the larva enters the soil, the pupa changes to a fly, which digs its way out of the earth, and thus completes the cycle of the insect's life.

In the Northern states there are generally two broods of these slugs each season, the first brood appearing in June and the second in August.

THE FIREFLY.

WHAT a gay carnival season is the golden, glowing summer to the insect world! All day long butterflies flit from flower to flower, and bugs and beetles, in shining coats of mail, wander up and down the garden paths on their little errands, while the hum of bees and flies keeps up a soft accompaniment to the bird solos that ring out from the trees and hedges; and, turn which way we will, we find

> There 's never a leaf nor blade too mean
> To be some happy creature's palace.

But if the sunshine brings out the more gaily dressed of these little beings, the purple twilight has also its no less interesting forms, and even during the starlit midnight hours throngs of insects, in white or somber colors, noiselessly pursue their pleasures and perform the work that Nature gives them to do.

Among the insects that come out of their hiding places only after the sun has set is one that everybody observes and admires. I mean the firefly.

With what pleasure we follow its brilliant, intermittent sparkle over the lawn and among the shrubbery! The dusky scene becomes fairly illuminated on warm evenings in July and August with these innumerable little lights, ever vanishing and reappearing; sometimes a single

gleam, and then a great many flashes at once, as if the insects had agreed on forming a miniature constellation.

Fireflies are really not flies at all, but soft-shelled beetles; that is, the wing covers, instead of being hard, like metal or shell, are more like thin leather and can be bent without breaking, and they are not folded so closely around the body as in many species. There are several kinds of "lightning beetles" in different parts of the country, but the one which gives the brightest flash is found in the Middle and Southern states.

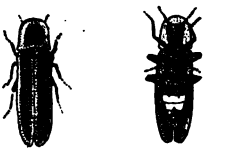


FIG. 10. — The Firefly Beetle, as seen from above and below.

Seen by daylight it is rather a common-looking insect, from one-half to three-fifths of an inch long, and of a flat oblong shape, as shown in Fig. 10. The wing covers are a dull black, with a narrow border of pale yellow. The head, with its large eyes, cannot be seen from above, as the shield-shaped top of the first joint of the thorax sets out over it like the brim of a hat, and only the notched antennæ, or feelers, appear. This little shield is of a dull yellow color, with a black spot in the center and one of bright rose red on each side. The hind body, on the under side, is dark brown, except the two end joints, which are of a clear sulphur yellow; and it is from these that the strange, brilliant gleam is given out. The material for this light, like that sometimes seen on

FIG. 11. — Under Surface of Abdomen of Firefly, showing the Light-bearing Rings. Magnified.

decaying wood, is supposed to be phosphorescent, and the flash seems to be produced by the influence of the nervous system acting upon the cells of the luminous portion of the body.

Under the wing cases which have been described are folded the large transparent wings by which it flies, though there is also a slight motion of the wing covers which are held straight out from the body. The flight is very graceful, a sort of slow swimming through the air, and though the motion is very rapid, no fluttering can be distinguished.

Almost every one knows the insect in its firefly form, but the two earlier stages, that of larva and pupa, are but rarely seen. The grub, or larva, lives in the soil and feeds on earthworms and soft-bodied insects. It is not yet known exactly how long this growing period lasts, but probably several months, as most burrowing beetle larvæ grow rather slowly.

When it has reached full size it is a smooth, distinctly jointed worm, about one and one-eighth inches long, showing thirteen rings, or joints, beside the head. On the top of each joint is a polished horny brown plate, marked with three white lines. The sides are pink or red, and the under surface cream color with brown markings. Each of the three joints behind the head is provided with a pair of jointed legs, but, unlike the larvæ of butterflies and moths, it has no prolegs under the middle of the body, and only one very curious one at the tail. This

proleg, or appendage, can be drawn into the body or thrust out at will, and not only assists the insect in moving about, but is used like a brush to clean the head and other parts of the body after feeding. Dr. C. V. Riley, who was the first to study its habits, says: "It is quite amusing to watch one of these larvæ as it deftly curls its body and stretches this fan-like organ over its head and literally washes itself."

FIG. 12.—The Larva of the Firefly Beetle. Back view and side view. Magnified.

This larva is quite luminous, a sort of glowworm, and after dark may often be found by this character when the soil in which it hides is stirred.

When it is full-grown it forms a hard, earthen wall all around itself, and in this it changes to a pupa. The latter is not very different in appearance from the larva, except that the upper part is thicker and the wing cases show plainly. It also glows with a faint, steady light. In about ten days it slips off its pupal shell and breaks out of its little earthen house and comes to the surface of the ground a perfect beetle, very soft and limp at first, but soon hardening and ready to join the other sparklers on lawn or meadow.

THE IO MOTHS.

THE other day a boy brought me a handsome caterpillar, looking like Fig. 13. It was two inches long, and in general color pea-green, with a distinct whitish line running along the lower part of each side of the body. Above this line there was a more or less distinct lilac-colored border. The head was shining green, with tiny black spots showing the position of the simple eyes, while the legs were brownish.

Each ring or segment of the body was adorned with strange bristly, yellowish spines, many of them tipped with black. These spines came out in little bunches, as may be seen in the figure.

My young friend complained that when he picked the caterpillar up in his hands it stung him, so that he dropped it. Then he rolled it into a burdock leaf and carried it safely.

On looking through a lens at the spines on the body we saw that each separate group of them projected from a sort of outgrowth of the skin, and were sharply pointed at the end. On touching them carefully one felt such a stinging sensation as is felt when a nettle leaf is touched.

The caterpillars were put in a box on the bottom of which had been placed a layer of soil covered with a hand-

ful of dry, fallen leaves. Some fresh clover was also added in case they should care to feed upon it. But the

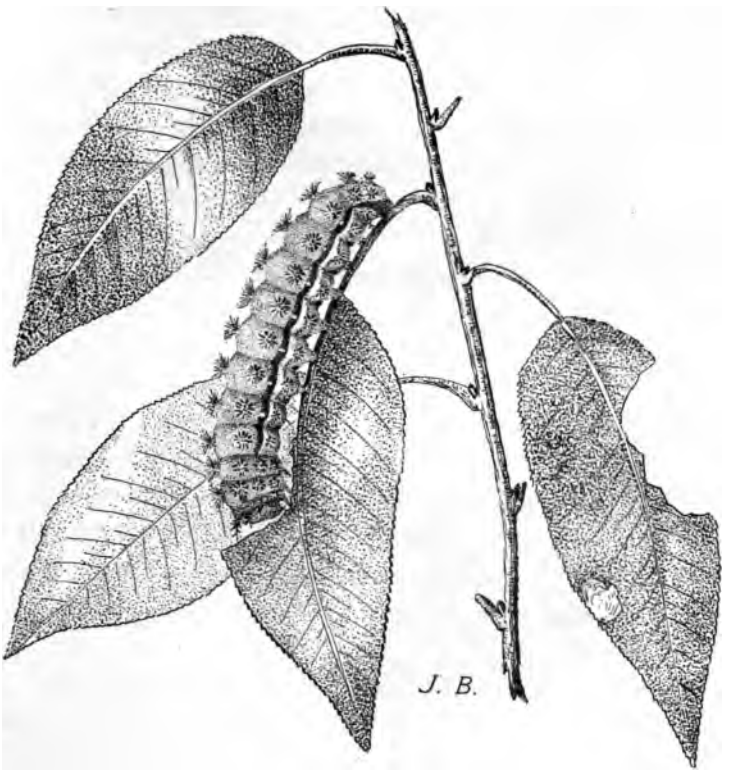


FIG. 13. — The Caterpillar of the Io Moth. Natural size.

eating period had evidently passed, for the caterpillars soon constructed thin silken cocoons with a few of the leaves on the outside, inside of which each changed to a brown chrysalis.

FIG. 14.—The Io Moths: Female above; Male below.

The box with the cocoons was put away in a cool cellar for the winter. Early the following spring it was brought out, and one fine morning in May each of the chrysalids was burst open at the end, and the box contained two

beautiful moths. But they were not alike. One was much larger than the other, looking like the upper picture (Fig. 14), with the front of its body and the fore wings of an unusual brown-purple color. Near the middle of each hind wing was a large eye spot, black with a lighter center. Around the eye spot the wing was of an ochre-yellow color, bordered on the outside with a narrow black band, and on the inside with an indefinite wide patch of purplish brown. Outside the black band there were two or three rather indistinct bands of yellow and brown. The antennæ, or feelers, on the front of the head were slender and not especially conspicuous.

On each of the front wings there were three rather indistinct light-colored bands, extending across in the positions shown in the picture.

The general color of the other moth was yellow, with the black spot and band on each hind wing in the same position as in the larger form. The inner border of these was purplish brown, and there was a stripe of the same color extending along outside of the wing near the margin.

In this moth the two antennæ looked like short feathers, having distinct divisions projecting nearly at right angles to the main portion.

These moths both belonged to one species, called the Io moth ; the larger one was the female, and the smaller the male. This species is a rather common one over a large part of the United States. It is one of the handsomest insects that we have.

THE PROCESSIONARY CATERPILLARS.

THE Io moths appear in early summer, flying about after dark, but remaining quiet during the day. The female moths deposit their eggs upon the leaves of several different kinds of plants, such as the wild cherry, the willow and poplar, the elm, the sassafras, the dogwood, and the currant, as well as upon clover and Indian corn.

These eggs are laid side by side upon the chosen leaf in clusters of twenty or more. They are very small, being less than one-twelfth of an inch long, and of a yellowish color. A few days later they hatch into minute, orange-colored, spiny caterpillars, with the head of a darker color than the rest of the body.

Soon after hatching, the little caterpillars have a curious habit of forming in line side by side to feed upon the leaf. By means of their little jaws they eat out the green substance. When they want to change the location of their feeding grounds, going to another leaf, or another part of the same leaf, if it be a large one, they form a procession as they travel. Sometimes they simply go in Indian file, one after the other, and sometimes they form $\wedge$-shaped processions. Dr. T. W. Harris, who watched some that adopted this method of moving, says that a single caterpillar takes the lead, "followed closely by one or two in single file, after which come two side by side; close upon

e heels of these creep three more; the next rank consists four, and so on, the ranks continually widening behind, ke a flock of wild geese on the wing, but in perfectly egular order."

Before they are many days old the caterpillars undergo heir first moult. After this the body is not so brightly colored, with certain lines along the sides showing more distinctly. One along the middle of the back is darker than the body color, while three along each side are yellow. The caterpillars continue feeding and marching in procession as before, of course eating more as they increase in size.

A week or so later they moult again; the markings become more distinct and the spines are better developed. After this moult they eat more than ever before, and during the next few weeks they continue to feed on the leaves, increasing in size and moulting three times before they become full-grown.

When the Io caterpillars are about half-grown they commonly cease marching in processions and act independently of each other. Their spines evidently serve as a decided protection in preventing birds and various other animals from attacking them. But they do not save the caterpillars from the attacks of certain insect parasites which deposit eggs beneath their skins. The eggs soon hatch into footless maggots that absorb the tissues of the host and finally kill it.

A QUEER LITTLE NURSERY.

A LADY who was sewing one warm day by an open window was surprised by a visitor whom she did not remember ever to have seen before. The stranger came in quite familiarly, softly humming a tune, and dropped down upon the window sill to rest. She did not answer the lady's greeting in words, but made many odd little bows and curtsies, as she looked around with her large eyes and seemed to take a very careful survey of the room and its furniture. She had a neat, slim figure and was dressed in glossy black, trimmed with pale yellow, and wore a gauze scarf. The spools of thread on the window sill soon excited her curiosity, and presently, to the lady's astonishment, she walked, head-foremost, into a "No. 40 Coats"!

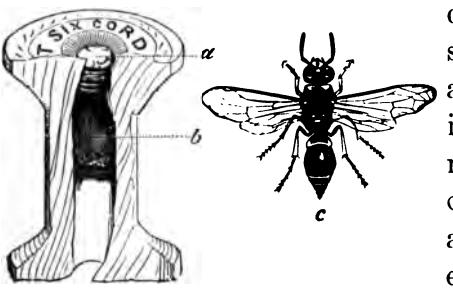


FIG. 15. — A Wasp and its Cell in a Spool.

"Why, it must have been a fairy!" you will say. And so it was, indeed. Not exactly the sort of fairy that we read of in Grimm's *Tales*, which would look like a boy or girl seen through the wrong end of a telescope — but a *real* fairy, one of the millions of little people who live in

our fields and woods and gardens without paying us a cent of rent, and carry on the most wonderful business, almost under our eyes, of which we know nothing at all. But to make the matter plain, this singular-acting visitor was a little mason wasp, who was looking about for some convenient place in which to build her nursery. The inside of the spool seemed to be the very spot for which she was searching, and after buzzing about for a few minutes, she backed out and darted swiftly away through the air. In less than five minutes she returned with a lump of damp clay, about the size of a sweet pea, tucked under her chin.

This she carried down into the spool and stayed there some time pressing it into place, after which she came out and flew away, to return very soon with more clay. This she did three or four times. After the fourth flight she was gone for a much longer time, and when she again appeared was carrying, with some difficulty, a green measuring worm, nearly an inch long. She seemed very tired and, still holding the worm, sat for a short time on the end of the spool to rest. Then taking a good hold of it with her jaws and allowing it to slide under her body, she dragged it into the spool and seemed to take great pains to coil it up and press it together, so that it should not occupy much space. When it was adjusted to suit her she came up and flew away, returning soon with another worm of the same kind, and went through the same motions in packing it away. The third time she

brought another sort of larva, and the fourth time still another. As she returned with this, the lady, who was watching her with great interest, made a slight motion, which frightened the wasp, and she dropped her burden before reaching the spool. For a moment she seemed very much bewildered, turning round and round and buzzing noisily, but instead of picking up the worm, flew off for another.

While she was gone the wounded larva was examined with a lens, and the places where the wasp had stung it could be plainly seen. These stings were not severe enough to kill it, but rendered it almost motionless and helpless to escape. It was taken up and placed upon the edge of the spool, but when the wasp came with still another larva, she took no notice of it and pushed it off in making her way into the hole. She remained hidden for a long time and, after her next flight, came back with more wet clay; so the lady knew that one little cell was finished and stored with food for the wasp baby, and that the egg was laid from which the baby would hatch.

As soon as the first cell had been closed up another was begun, and for an hour and a half the industrious little mother continued to carry clay and small, smooth caterpillars until three cells had been made and supplied, and the spindle hole in one spool was full and all nicely plastered over the top.

Several times during the process, either from weariness or because she had been startled, she dropped her insect

or bit of clay, and never once would she pick them up, but always started immediately for another load.

When the first spool was finished she began without delay in another; but by the time the first cell in this was closed up, it was so late that she went away to rest for the night. The window was carefully closed and the spools of thread that had been made use of were left standing, and other empty spools were looked up and placed beside them.

Soon after the window was opened the next morning, the wasp appeared, to see if everything was as she left it, and seemed well satisfied with the state of affairs. The cell building went on until by the afternoon of the third day she had filled nine spools, the smallest with two, others with three, and the largest with four cells. When this was done she flew away, to return no more.

The spools were all firmly masoned to the window sill, and scattered about among them were many pellets of clay and paralyzed larvæ that had been accidentally dropped. One of the last-filled spools was examined and found to contain three cells, separated by plates of fine mortar which was almost as hard as cement. The side walls were not plastered. When the spool was loosened from the window sill the contents of the lower cell fell out. They consisted of six larvæ, "geometers" and "apple worms," the former more than an inch long, and the latter making up in plumpness what they lacked in length. It did not seem probable that a single wasp baby could

require so much food, but no doubt the little mother knew.

The small, oval, white egg from which this baby was to hatch was attached to the side of the cell by a short hair-like stalk. It was no easy matter to pack these limp but living larvæ back into the cell, but they were crowded in as well as possible and held there by a little plug. Two days later, they were again turned out, and there was the tiny wasp larva with its head buried in one of the apple worms. It was spindle-shaped and of a glossy, greenish-white color. In a week it had eaten all its provisions and seemed to be full-grown.

It was now more than half an inch long and quite thick through the middle of the body. Soon after, it was found in the pupa form, very soft and cream white, but showing the wings and legs and mouth parts of the perfect insect. In less than a week it came out a full-fledged wasp, like its mother. Some reader may wonder how the wasps in the lowest cells, which would be the older, could get out without hurting the younger ones above them. But it was found that they all got their wings about the same time, and those in the upper cells came out first, followed very soon by those next below them. In less than two weeks every spool was empty again, and the insects came no more to the window sill that summer.

This wasp is quite troublesome at times when it clogs up the keyholes of doors and furniture with clay and worms, and it also stings quite severely, if accidentally

squeezed or roughly treated; but for all that it makes a most interesting subject for study, and will build its nest in any little tube, like a pencil case or penholder, that may be provided for it.

There are two or three broods during the summer, and where they are abundant there is no doubt that these little wasps destroy a great many leaf and fruit-eating caterpillars and should therefore be regarded as among our insect friends.

THE FALL WEBWORM.

THERE are but few insects that have the habit of living together under webs or other protection. Those that do always attract much attention. Perhaps the best known of these is the tent caterpillar, so commonly found in spring. In this story you will learn of another species of caterpillar that, with its brothers and sisters — four or five hundred of them — also lives under a single web until fully or nearly grown.

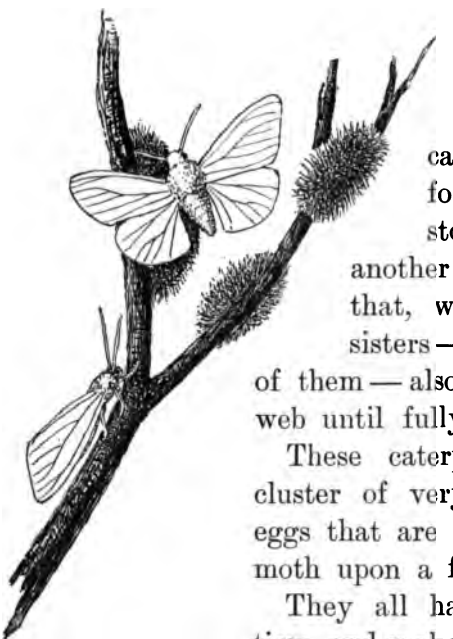


FIG. 16. — Moths and Cocoons of the Fall Webworm.

These caterpillars hatch from a cluster of very tiny, golden-yellow eggs that are placed by the mother moth upon a fresh green leaf.

They all hatch about the same time, and make their first meal upon the juicy green substance of the leaf. Then they all begin to spin, and by some mysterious knowledge the work of one little worm fits onto that of another, so that in a few hours a fine

thick web is so spread over the leaf that the entire family is safely sheltered. In a day or two the web is lifted and made larger so as to take in more leaves for food.

It will be seen that these insects, unlike the tent caterpillars, do not use their webs merely as lodging houses, always going out for their meals, but never leave them for any purpose. When they have eaten up all the leaves on one twig they stretch the web over others, until often they have enclosed a large branch. These webworms are by no means neat housekeepers, and their webs soon begin to look very disagreeable and untidy, with bits of stems and dried leaves and all their old clothes and other litter scattered about in every direction. When not eating they stretch themselves out to rest upon the twigs and branches that form the framework of their house.

When very young all the little caterpillars are pale yellow, with two rows of black dots down the middle of the back. But, like all other larvæ, they moult or change their skins several times, and each new skin shows a somewhat different pattern. When full-grown they are over an inch long and about one-fifth of an inch thick. Every one has a black head, and the general color of the body is very pale green or yellowish white. A yellow stripe runs along each side, but otherwise they are not all alike. Some have the back merely dotted with black, while others have a broad stripe down the middle. They

are covered with long white hairs that arise from black and yellow warts.

It sometimes happens that before they are full-grown there are no more leaves that can be conveniently drawn into the old web. Then a grand "moving" takes place, generally in the night, and by the next morning if you look for the family you will find them very busy getting settled on a distant branch of the tree.

One would not think that these webs, through which one can see almost as easily as through a veil, would serve to protect them from birds and other insects; but as a matter of fact they do, for the web is tough and sticky, and the few birds which eat hairy caterpillars dislike to peck into them, while only the largest of their insect enemies, such as the mantis, the wheelbug, and the red social wasp, have the strength to break into the nests and carry off the caterpillars.

In about a month from the time of hatching they break up housekeeping and crawl away in every direction. While they were young, if for any reason they left their home they always kept up a connection by means of a silken thread, and would drop and hang by this; but when they finally scatter they simply coil themselves into a ball and drop to the ground, the long hairs with which they are clothed forming a sort of spring cushion to break the fall. Once on the ground they crawl about very rapidly in search of some safe shelter under which they may rest while changing their form. They find such

places under bits of bark and dry leaves, sunken places around fence posts, and sometimes by burrowing into loose soil. Then they spin thin cocoons, into which they mingle the hairs from their body, and soon cast off the caterpillar skin and appear in the form of a shiny brown chrysalis, about half an inch long, rather thick, and slightly bulged in the middle.

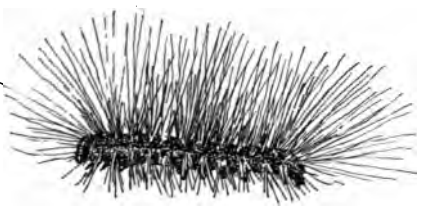


FIG. 17. — The Fall Webworm.

In the more northern states there is but one brood of these insects in a year, and the worms are seen on the trees only during the latter part of summer. When these change to pupæ they rest in that state for many months, and the next June or July they break through the chrysalis shell and cocoon in the form of very pretty white moths with large brown eyes and feathered antennæ. While most of them are pure white with only tinges of yellow on the edges of the wings and on the legs, some of them are sparsely and others thickly dotted with black.

In the latitude of Washington and St. Louis and southward there are two broods of this insect. The first webs appear on the trees early in June. The pupa state of this brood lasts only seven or eight days before the moths come out. The second brood of worms are found in August and September, and this does the most damage.

The webworms feed on the leaves of almost all kinds of trees except evergreens, but they prefer those of the box elder, elm, poplar, and ash. They are also often found on apple, plum, and pear trees, as well as on many choice shrubs and berry bushes.

As the worms are nearly always "at home," they can be removed from the trees by means of a long pole with some cloth or brush tied to the end, to which the web with the caterpillars will stick. Some fruit growers fasten a torch to the pole and burn them out of their apple trees without much injury to the tree.

THE WEBWORM TIGER.

If it were not that the webworm has a great many natural enemies, it would soon overrun and destroy many of our choicest forest trees, and give fruit growers much trouble to save their orchards from serious injury. But, fortunately, it has these enemies — a great many of them — among which we find the screech owl, the black and the yellow-billed cuckoos, and the toad, as well as several spiders and fully a dozen insects large and small.

Only a few of these birds and insects attempt to get the caterpillars from their webs, and so as long as they keep under shelter they are not much troubled. Their time of danger comes after they are full-grown and are crawling on the ground, or after they have changed to pupæ and to moths.

A few years ago, however, it was found that they had one enemy which lived with them in their webs and gave them no peace day or night. This is the larva of a small, dark-brown hunting beetle, which is a most savage and greedy little creature, and in the course of its growth kills a great number of the worms. About the time the webworms begin to hatch, the beetle, in running about over the tree, comes across them, and stops long enough to place a few pearl-white

Fig. 18. — The Parent Beetle of the Webworm Tiger.

eggs in the midst of them. In a few days these eggs hatch into active little grubs which are white underneath and on the sides, and black on top, and are shaped something like an alligator. They begin at once to torment the worms, biting into their necks and sides and drawing out the blood. At first they do not make fatal wounds every time they take a meal, and the caterpillars go on eating, and some get over the hurt, but soon the little "tigers" gnaw such holes into them that they crawl away and bleed to death. When a tiger is hungry he attacks the first worm he comes across, and in this way he often kills a great many in a day. Where there are only five or six of these in a large colony of webworms a good many of the latter will escape injury. But when, as often happens, a large number of eggs are laid by one or several beetles under the same web, so that from fifteen to twenty little tigers have to get their living in the same colony, the webworms have a very hard time. In such cases, though they may not be half-grown, they generally try to escape from their enemy by moving and by breaking up the family into smaller groups. It is but seldom, however, that they can entirely get rid of the beetle larvæ in this way, although the majority may be left behind to subsist as best they can on such worms as were not able to crawl away. A few who were probably attached to caterpillars

FIG. 19. — The Webworm Tiger. Magnified.

would go with them and continue to annoy the latter in the new home.

The beetle larvæ moult three times, and are full-grown when between two and three weeks old. They change to white and very delicate-looking pupæ within the web where they grew, and about ten days afterwards appear as beetles. These leave the webworm nests in the course of a day or two and run about until the next brood of webworms appears, or, sometimes, in the fall, attack other webbing larvæ.

They pass the winter in the beetle state, hidden under fallen leaves and various sorts of rubbish on the ground. In these situations they are liable to be drowned out or washed away during rainy winters or very wet springs. This, perhaps, accounts for the fact that some seasons they are so abundant in certain localities that they are able to break up almost every colony of webworms, while the next year they may be so few that the caterpillars have a chance to multiply, and again become a serious pest on fruit and shade trees.

THE PURSLANE CATERPILLAR.

In the great central region of the United States, especially in such states as Ohio, Illinois, Indiana, Missouri, and others adjoining these, a bright-eyed boy who wanders much afield will often come across a large yellowish-green or brown worm, feeding upon low-growing plants

Fig. 20.—The Greenish Purslane Caterpillar.

like purslane, or "pusley," turnips, buckwheat, and others. This worm is about four inches long, nearly an inch in diameter, and has a curious horn projecting upward at an angle from the hind end of the body.

There is a strange variation in the color of these worms. Some of them are yellowish green, looking like the figure above, while others are brownish black, having the appearance of the figure on the next page. Along each side of the back of the yellowish-green ones you will see a row of spots. Each spot is colored crimson, yellow, and black, the crimson being toward the middle, and the black on the outside.

The spots are connected with each other by a black and yellow line.

Low down on the sides of these yellow-green caterpillars, just above each of the legs, you will see a somewhat crescent-shaped black or black and yellow spot. If you look closely at the middle of one of these spots, you will notice a small, vertical, slit-like opening. Look at one of these holes through a hand-lens, and see the lip-like margins around it. See if there is any movement of these

FIG. 21. — The Brown Purslane Caterpillar.

margins, suggestive of the opening and closing of the openings.

These holes along the sides of the body are in a sense the nostrils of the caterpillar. Instead of breathing as you do, taking the air through two nostrils into the lungs, where it comes in contact with the blood from all over the body, the caterpillar takes air into its body through these holes, which are the outer openings of small air tubes — technically called *tracheæ* — that run through all parts of the body, letting the air come in contact with the blood wherever it is. These holes are called the breathing pores, or *spiracles*, of the insect.

If you find one of the brownish black "pusley" caterpillars, you will see that it has along the middle of its back a yellow line, as well as rows of yellow spots along the sides of the body. Possibly you may find one so black that even the yellow line is not present, for these caterpillars differ from each other in a very remarkable manner.

You will see a curious difference in the legs along the underside of the caterpillar. In front, just back of the head, are three pairs of jointed legs, which are rather slender and taper to a point. Look at the tips of these legs with a lens to see if there is any sort of a claw. Back of these slender legs there is a smooth space. Then you come to four pairs of large, wide legs, without distinct joints. Look closely at the tips of these to see what there is along the edge. Back of the last of these four pairs there is another smooth space, and then you come to a final pair of thickened legs of similar structure. All of these large legs are called *prolegs* to distinguish them from the front or thoracic legs.

Which are these prolegs best adapted to — walking along a smooth, flat surface, like the top of a table, or along a round stem, like the stalk of the purslane plant?

Now notice the "horn" on the end of the body. Ignorant people will sometimes tell you that the caterpillar can sting with this. But if you use a microscope you will find that there is no opening in the tip of the horn, and you may be sure it has no stinging power.

Turn now to the head of the caterpillar, and see if you can distinguish the jaws. Watch, if you can, one of the worms while it is feeding, and see how the jaws are used. On the front side of the head can you see any small rounded bodies that might serve as eyes? And see also if you can find any objects that correspond to the antennæ, or feelers, of adult insects.

THE PURSLANE CATERPILLAR BECOMES A MOTH.

THE full-grown purslane caterpillar may be found late in summer. If you put one of them in a jar or box holding several inches of garden soil,—of course covering the top with gauze or glass to prevent the escape of the insect,—you will probably be able to learn its future history.

After you have kept it for a few days, it will be likely to disappear from the surface by burrowing down into the soil. Do not disturb it for one or two weeks. Then, if you wish, you can carefully empty out the earth and search for the caterpillar. Very likely you will not find it, but will find instead a curious brown object.

This object is the pupa of the purslane caterpillar. When the latter had burrowed down into the soil some distance, it stopped, and wriggled around until it had made a hollow cell, of a somewhat oval shape, by pushing against the earth surrounding it. Its body then became shorter and thicker. Finally the skin split open along the back, and the insect again wriggled until the skin slid off, and there remained the creature looking much as it does now, though not so deeply colored. Then it quieted down, for it had no legs to walk with, nor wings to fly with, nor mouth to eat with, nor ears to hear with, neither had it any antennæ with which to feel its way. Consequently there was every reason why it should keep

FIG. 22. — The Moth of the Purslane Caterpillar.

quiet, and besides all this, many strange changes were going on inside the brown shell. The various organs of an adult insect were gradually being formed.

It will be wise for you to put this pupa back in the soil, covering it with two or three inches of earth, which should be kept damp, but not too wet. In the course of the next two weeks it is probable that the pupa will wriggle to the surface, when its outer shell will split open and a beautiful moth will emerge. It is likely to rest quietly for some time to get well dried off.

These moths rest with their front wings laid over the back in a sloping position, thus covering the hind ones. In general color the front wings are greenish olive. Extending obliquely across each, from the hind margin at the base to the tip, there runs a rather wide stripe of a pale buff color. Extending along the outer margin, from the tip backward, there is another stripe, slightly wider than the first, and of a dull grayish color. The position of the larger veins is shown by whitish lines.

The hind wings are much smaller than the front ones. In color they are blackish and rosy red, the latter showing as a central band. Along the hind margin there is a whitish fringe. The front of the body has whitish stripes, as shown in the picture, while on the abdomen are longitudinal rows of black and white spots.

On each side of the upper part of the head there is a rounded compound eye, from in front of which project two club-shaped antennæ. On the underside of the head

you may find a curiously coiled tube. You can easily uncoil this, and will be likely to be surprised at its length. This is the tongue, through which the nectar of flowers is taken into the mouth.

When they are at liberty, these moths fly very swiftly. They belong to the great group of Sphinx moths which appear on the wing in the twilight period rather than during the lighter hours of the day, a time when most species of these sphinxes rest in such concealed positions as they may be able to find. When on the wing, they make a humming noise similar to that made by humming birds, and in consequence are frequently called humming-bird moths. They are also commonly spoken of as hawk moths, presumably because of their rapid hawk-like flight and their manner of hovering in front of flowers. They feed upon the nectar of many blossoms, especially those with long tubes, like the honeysuckles, the evening primroses, and some of the lilies. In getting the nectar they hover in front of the blossom and thrust in their tongues, in much the same way that a humming bird gets its food.

The particular species of moth we have been considering is called the white-lined morning sphinx. It differs from many of the other sphinxes in that it often flies abroad during the middle of the day, especially if the sky is overcast with clouds. At such times the moths may be frequently seen flying about flower beds, busily sipping the nectar in the blossoms.

AN INSECT MOTHER AND HER BROOD.

THERE is an oddly shaped little leaf-hopper often seen in summer on sunflowers and other plants of the same family. It will be easily recognized from the picture, but is only one-fifth of an inch long. In color it varies from light brown and yellow to a very dark brown with scarcely any spots or shadings.

Late in the summer each mother insect prepares a place for her eggs by gnawing off the outer skin of one of the large veins on the underside of a leaf. Then she pushes from twenty to thirty tiny eggs into the soft tissue of the leaf and stations herself over or beside them until they hatch. When, in about a week, the young hoppers come out, they stay close together near where they were hatched and stick their little, sharp beaks almost side by side into the leaf to pump up the sap on which they subsist. The mother, unlike most parent insects, does not fly off and leave them to their fate, but hovers over them much as a hen guards her brood of chickens. It is even quite difficult to frighten her away, and if driven to another part of the leaf or to a neighboring leaf, she will run about in all directions until she comes across her own little flock, beside which she will again take her place.

FIG. 23. — Leaf-hopper. Back and side views. Magnified.

The young hoppers do not look much like their mother, having soft, fuzzy bodies, large in front and tapering to a point behind. They are green in color, with brownish-red heads and collars, and a broad band of the same color across the middle of the back. They change their skins every few days and move from place to place on the leaf in search of the most juicy spots, the mother always going with them. Occasionally, when they are nearly grown, the family separates into two or three groups, some of them often removing to another leaf. This separation is, perhaps, that they may not attract too much attention by their numbers and also that they may be sure of a better supply of sap. The mother insect stays with one or the other of these companies until they are all fully grown and appear with wings and wing covers like her own, after which she can no longer be distinguished from them.

In all stages of their life these insects are very sociable and feed and move about over the leaves in companies. It is but rarely that we find one by itself.

Although they can fly with ease and jump great distances, besides being able to run quite rapidly, these little *Entilias*, as they are called, are not great travelers, and when not disturbed spend their lives not far from the spot where they were hatched.

A lady who gave some time to observing the habits of these insects in her garden says that they are great favorites with some kinds of ants, which herd them and attend

them in the same way that they do the aphides. She even saw the ants assisting them to get off their outgrown skins and driving them into clusters when they seemed disposed to wander.

It is supposed that the ants get from them some sort of agreeable fluid in return for their attentions similar to that obtained from the honey tubes of aphides, which are often called the "ants' cows."

Perhaps the leaf-hoppers do not care for the presence of the ants, as they always seem more restless and scattered about on leaves where the ants have found them, in spite of the efforts of the latter to keep them together.

THE LIFE HISTORY OF A LADYBIRD BEETLE.

DURING summer one may often find on trees and other plants infested by plant lice the pretty little beetles commonly known as "lady-birds" or "ladybugs." These insects form one of the most interesting families of their class. They are nearly all of neat and handsome appearance, having rounded or oval forms and bright, attractive colors.

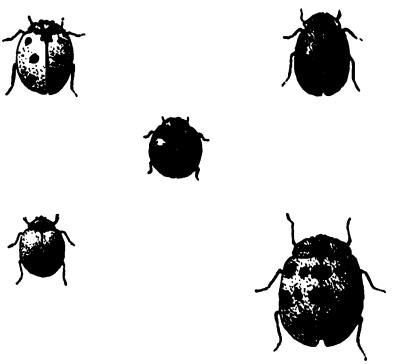


FIG. 24.—Five Common Ladybird Beetles.

There are many different species in the lady-beetle family, but with few exceptions they resemble each other in life history and habits. They are all quite small, with the wing covers hard and shining. Both thorax and wing covers are either of black or dark colors ornamented with red spots, or of light colors with many or few black spots or markings. They are very tame and friendly, but, it is said, will always fly off in a hurry when children say:

> Ladybird, Ladybird, hie away home,
> Your house is on fire, your children will burn!

These poor ladybird children! fire is the least of the dangers to which they are subject. The very people who regard their parents with so much favor will often destroy these young ones by the dozen, under the mistaken idea that they are killing some very injurious species.

Do you wonder how this happens? The explanation is found in the fact that the young do not bear the slightest resemblance to their parents, being tadpole-shaped, with hungry-looking jaws and awkward legs, and are clumsy in their movements. They are also commonly found in the company of insects that are doing serious injury to valuable plants. Often the insects that are doing the damage are entirely overlooked, and the ladybird young, which were engaged in eating up the destructive species as fast as they can, are killed instead of the sap-suckers. It seems a great pity that this should be so, and the only way to prevent the destruction of these little friends is to become acquainted with their appearance and habits and to introduce them to as many people as possible, telling the latter what good service they do, and urging them to be careful not to injure them.

The small yellowish eggs of the ladybird beetles are deposited on the twigs or leaves of trees, shrubs, and other plants. These eggs are very similar to the eggs of the common potato beetle. In a short time they hatch into little larvæ, which are rather long, active creatures of various colors. They have six well-developed legs and are generally covered with bristly hairs.

These ladybird larvæ feed upon the plant lice, devouring them greedily. As the larvæ grow, they shed their skins occasionally. In a few weeks they become full-grown (Fig. 25), so far as this part of their life is concerned. They are now ready to enter upon the next stage of their existence. To do this, each larva attaches the hind part of its body to a leaf, the bark of a tree, or some similar object, and soon sheds its skin.

FIG. 25. — The Larva of a Ladybird Beetle.

FIG. 26. — The Pupa Skin of a Ladybird Beetle.

On the completion of this process of moulting, the insect assumes a peculiar appearance, that can be pictured better than described. So I will ask you to look at Fig. 26 and see what sort of an object the *pupa* of a ladybird beetle is. This figure, however, represents only the empty pupa skin; in the pupa the black opening at the lower end would not be seen.

The insect remains in this motionless pupa state a week or ten days. Then it emerges as an adult beetle, similar to the one which laid the eggs a few weeks before. These beetles also feed upon aphides, although less eagerly than do

the larvæ. Sometimes they do not hesitate to eat the eggs of other ladybird beetles. A few years ago, in an apple orchard in southern Illinois, I saw some of them thus engaged in eating the eggs of their fellows. But as a rule these beetles are friendly to man, preying upon insects destructive to his crops.

THE USEFULNESS OF LADYBIRDS.

WHILE the ladybird larvæ often kill young caterpillars and eat the eggs and young of potato beetles, they are most likely to be found among the colonies of little plant lice or aphides that are such a nuisance and injury on our fruit trees and flowering plants. Often in a few weeks,

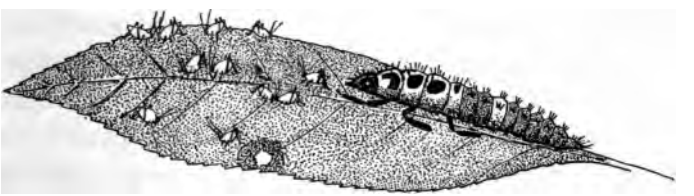


FIG. 27.—A Ladybird Larva Hunting Aphides.

sometimes aided by a few other larvæ of similar habits, these useful insects will entirely clear a garden of aphid pests.

Some species feed upon scale insects or bark lice and are of the greatest importance in keeping them in check. A few years ago a very destructive scale insect appeared in the orange groves of California. The owners feared that they would lose all their trees and were very much discouraged. They consulted Dr. C. V. Riley, who was then United States Entomologist, and he undertook to discover a remedy for the trouble. He first found out,

by means of much writing and looking up of papers, that the insect called the "cottony cushion scale" had come to California on trees imported from Australia. He next learned that in that country the scale did very little damage, so he concluded that in its native land it must be kept in check by some natural enemy. Acting on this supposition he sent a young man to Australia to examine into the matter, who soon found that it was the larvæ of two or three ladybird beetles that kept the scale from multiplying. The difficulty was to bring them alive to this country, as the danger was that they would starve or become diseased on the long voyage. However, after a few unsuccessful attempts, a small number reached California alive and were placed on some scaly orange wood where they began at once to eat up the bark lice. They were carefully guarded and seemed to do well in their new home. As soon as enough of them had been bred they were distributed to all parts of the state where they were needed, and very soon the cottony scale began to diminish in numbers and the orange growers grew hopeful. In the course of two or three years the crops of fruit again became enormous and brought great wealth to the state, and all through the agency of a tiny red-and-black beetle and its greedy larvæ.

In some parts of the United States where hop-growing is an important industry, the ladybird larvæ are greatly prized because of their aid in keeping in check the aphides that are so destructive to the hop plant.

A few years ago the grain aphis did much damage to wheat and oats in many of the states in the Ohio and Mississippi valleys. Great numbers of ladybird beetles and their larvæ appeared in the infested fields, and, aided somewhat by certain parasitic insects, soon exterminated the aphides.

I am sorry to say that there are a few "black sheep," even in this useful flock, who do not confine their diet to injurious insects, but have, themselves, taken to vegetable food. These are rather large-sized beetles of a yellow color, spotted with black. Their larvæ are somewhat shorter than those of the cannibal species, black, and have several fringed lobes on each side of the body. One of these infests cucumber and melon vines in the Northeastern states, and one is very destructive to beans in the Southwest, eating holes in both leaves and pods, sometimes doing much damage. As a rule, however, the ladybird beetles deserve all the favor and protection they receive, and their young, which really do us the most service, should be recognized by every one, and care taken to preserve them from injury.

THE TOMATO WORMS.

LATE in summer and early in autumn one can generally find on tomato vines in the garden, portions of the plants

FIG. 28. — The Tomato Worm.

on which the foliage has been partially eaten off, so that the branch looks bare beside its full-leaved neighbors. In

such cases a little search will nearly always lead to the discovery that the author of the mischief is a large, light-green worm, with several oblique, whitish stripes along the sides of the body, and a peculiar spine projecting from its posterior end. This is the insect commonly called the tomato worm, or tomato caterpillar.

If one of these caterpillars be put into a covered jar or box having several inches of damp earth in the bottom, it can easily be fed fresh tomato leaves every day or two, and kept until it is full-grown, when it will be about three inches long. It will then stop eating and burrow down into the soil. Were it out of doors it would go down a considerable distance and at the bottom of its hole enlarge the opening sufficiently to form an earthen cell. It then casts off its caterpillar skin and becomes a pupa, or chrysalis. It is now very different; the legs have disappeared, and the shape is similar to that of Fig. 29, herewith. On one end is a long and slender tongue case, suggestive of a jug handle. The color is chestnut brown.

FIG. 29.—Pupa of Tomato Worm.

The insect remains in this quiet pupal condition until early the following summer. Then the pupa wriggles its way upward to the surface of the soil; the brown case splits open, and there emerges an insect with crumpled wings, that soon expand, so that the creature becomes the

beautiful "hawk moth" represented in Fig. 30. The ground color of the body and wings is gray and there are

FIG. 30. — The Parent Moth of the Tomato Worm.

various dots and stripes of different shades. On each side of the abdomen — the hind part of the body — there are

five orange-colored roundish spots. The eyes are round and prominent; over them project two large *antennæ*, or feelers, with feather-like processes on the front edge. But perhaps the most curious part of the insect is the long, coiled tongue at the mouth. This is usually coiled up tight, but it can be uncoiled readily. It is then seen to consist of a slender sucking tube three or four inches long.

This moth, with others of its kind, remains quiet in some sheltered nook during the day, but at dusk it starts out on a rapid flight in search of flowers from which to suck up nectar — the honey-like liquid found in many blossoms. Large, light-colored flowers, like the white lilies, are most easily seen during the evening. For this reason they are most likely to be selected by the hawk moths, but honeysuckles and many other blossoms are also visited by the insects.

These hawk moths have also another object in view during their nocturnal flights. If you watch the tomato plants in a garden at dusk during the summer, you are likely to see one or more of these moths flying rapidly from plant to plant, stopping at each one a moment. In this way they deposit eggs upon the leaves. In a few days the eggs hatch into little green caterpillars, that feed upon the green portions of the leaves about them. A week or so after hatching, they have increased in size to such an extent that they are too large for the skins with which they were born. Instead of this skin enlarging

with the individual, as it does in the higher animals, in these caterpillars a new skin is formed beneath the old one ; the latter splits open along the back near the head, and the caterpillar crawls out, clothed in a new suit. This moulting process is repeated several times during the next few weeks, in which the caterpillars rapidly develop until they become full-grown. Then they go into the earth to change to the pupa, or chrysalis stage, in which condition in northern regions they remain through the winter.

These hawk moths are so called because of a resemblance in their swift flight to the motions of a hawk. They are also often called the sphinx moths. If looked at through a lens, one sees that their wings are covered with minute scales, so that the moth belongs to the great order of scale-winged insects — the Lepidoptera, in which are included the butterflies and moths.

Late in the summer you may often find tomato worms as well as other sphinx caterpillars, which are more or less covered with such small white oval objects as are shown in the accompanying picture. Perhaps if you did not know the story of the caterpillar's life you might think these things were the eggs. But of course you know they cannot be the eggs, for these are laid by the moth upon the leaves of the food plant.

These little silken objects have an interesting history, however, and a very unpleasant one so far as the caterpillar is concerned. Some weeks before, a little black fly lit upon the back of the caterpillar, and laid inside his

skin many tiny eggs. In a short time each egg hatched into a little grub, that absorbed the body juices of the caterpillar. These *parasites* continued to grow at the expense

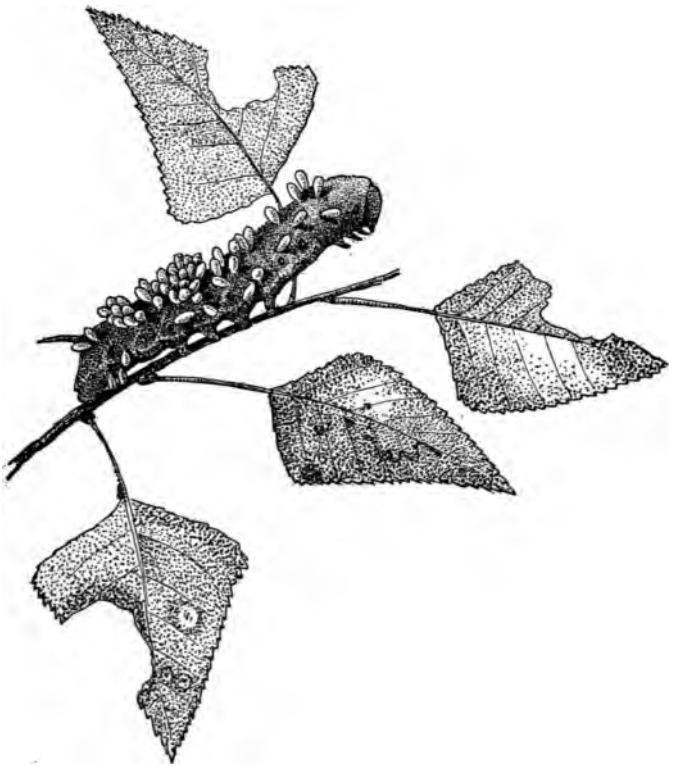


FIG. 31. — A Caterpillar Carrying the Cocoons of a Parasite.

of their unwilling *host*, the caterpillar, for some time before they became of full size. Finally they were ready for the next change; they burrowed through the skin of the

caterpillar, and each parasite larva spun about itself a silken cocoon, inside of which it soon changed to a pupa.

So each white object is a cocoon and contains a pupa. About two weeks from the time the cocoons are made, the pupæ change to flies, each of which gnaws off the end of its cocoon and comes out into the world.

The poor caterpillar lingers for some time in a half-dead condition before it finally dies, without completing the later stages of its growth.

THE PREYING MANTIS.

"Oh, what an ugly, wicked-looking bug!" some Northern child may exclaim as he looks at this picture. "See, how strange its head is and what big round eyes it has,

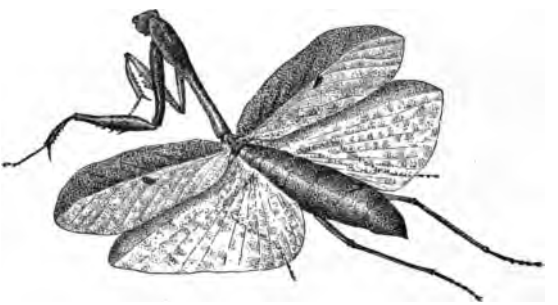


Fig. 32.— The Preying Mantis.

and how funnily it holds up its front legs! I 'm glad it does n't live in our part of the country. I would just as soon come across a rattlesnake."

But the Southern boy would say: "Why, these don't do any harm. *We* are not a bit afraid of them. We call them 'devil horses' and 'rear horses' and often drive them about with strings tied around their long necks. I tell you, it is great fun to see them fight, and they are quicker than lightning in catching flies."

Many other names besides those mentioned are given to these singular insects in different parts of this country

and Europe. The English call them "camel crickets," on account of their long necks, and also "intelligence bugs" and "diviners," from their wise and threatening expression, and "praying nuns," from the apparently devotional way in which they hold up their front legs. The best writers on insects agree in calling them mantes (singular, mantis).

It is not wonderful that their weird look and unusual habits should have caused people formerly to regard them with superstition; and many, not only among the foolish and ignorant, but of those who were quite well educated, believed that these insects had a knowledge of future events, and it was the custom of those who were about to start on a journey or engage in some new enterprise to consult one of these insects; they thought they could tell by the motions of the mantis whether or not they would be safe and prosperous.

There is a story of a pious monk of olden times who, seeing a mantis moving slowly forward with its fore legs raised, thought it must be engaged in prayer and ordered it to sing aloud, whereupon, as the story goes, the insect immediately chanted a hymn.

Another old author writes: "So divine a creature is this esteemed that if a childe aske the way to such a place, she will stretch out one of her feet to show him the right way and seldom or never misse." The Hottentots are said to go still further and to worship a certain kind of mantis as a god and to look upon

any one upon whom one of these insects may alight as a saint.

In this country, people are more apt to imagine that their motions predict famine, death, and other calamities, and nobody is very anxious to be made a saint by having a mantis suddenly drop down upon him.

The species of mantis are most numerous in tropical countries, where their forms imitate leaves, buds, and stems so exactly, even to spots of mildew and torn edges, that when they are sitting still it is impossible to tell them from certain parts of the tree or shrub on which they are resting.

The only common species in the United States is the one shown in the picture. It is not so odd and leaf-like in its form as some of its more southern relatives; but its color and shape, as it rests among the branches of bushes and grapevines, make it very difficult to discover. The body is long and somewhat flattened, and the first joint of the thorax is smooth and stick-like and has the appearance of a very long, slim neck. The head is in the shape of a triangle, with a large round eye at each upper angle and the small, but strong, sharp jaws at the lower, the mouth feelers resembling a drooping moustache. The greatest peculiarity of this insect may be mentioned here, which is one not found in any other American species — the power of twisting its head in any direction.

The front legs, which are never used in walking, seem to have one more joint than those of other insects. The

thighs and shanks are very stout and are set on the inner edges with sharp teeth and spines, for holding and crushing the insects on which the mantis feeds. The second and third pairs of legs are rather slender and weak, and the insect is but a slow and unsteady walker. When full-grown the males have two pairs of strong, brown, membranous wings, with which they can fly long distances, but the females, which are much stouter and usually of a pale green color, have wings that only partly cover the hind body and can scarcely fly at all.

The mantes are among the lions and tigers of the insect world and are even more cruel than these, as they will kill and eat each other with as much relish as they do other insects, and they will not touch any food unless they can catch it alive. Strictly speaking, they do not hunt their prey, but have a way of holding themselves perfectly motionless among the leaves and twigs of plants, so that they cannot be distinguished from them, until some insect that suits their taste crawls or flutters by, when they make a sudden dash with their spiky front legs and rarely fail to catch even the most agile fly or leaf-hopper.

They are so fierce and cruel from the moment of hatching that as fast as they come out of their shells they hurry away in different directions to escape being fallen upon and eaten by each other. As they grow older they become still more savage, especially the females, which often, after playing awhile with their mates, will suddenly

spring upon them and tear them in pieces. In their relations to man, however, they are entirely beneficial, as they kill a great number of the pests of the vineyard and orchard and, bloodthirsty as they are, seldom attempt to bite, and would not be able to puncture the human skin should they try to do so.

FIG. 33. — Two Egg Masses of the Preying Mantis.

Late in summer the eggs are laid in a compact mass covered with a tough sort of silk, which protects them from the weather. These egg masses, which are attached to twigs of trees, posts, and vines, are often noticed during winter and always excite the curiosity of those who see them for the first time. They are of a dull-brown color, rather more than an inch long, and one-third of an inch thick and wide. The eggs are in rows, so placed that their edges form a sort of braided pattern on top of the mass. The latter is not so broad, but otherwise they resemble the familiar fossil called a "trilobite."

They should never be destroyed, as is sometimes done by those who imagine that they are some hurtful thing. On the contrary, it is a good plan to collect them from wild lands and place them where the mantes, when they hatch, can help to protect orchards and gardens from the bugs, flies, and caterpillars

that are so destructive. This has often been done with great advantage by observing gardeners, and is only one of many instances in which man, with a knowledge of insect habits, has been able to make such unlovely qualities as cruelty and voracity serve good purposes under his direction.

THE BAGWORM, OR BASKET WORM.

In many parts of the country we see in winter, hanging from the twigs of leafless trees or attached to evergreens, many tough little cone-shaped bags. They are apt to be most abundant on the shade trees of cities and suburban towns, but are found also in orchards. These bags are made of many layers of tough silk, with bits of sticks and leaves and evergreen needles fastened to the outside. They are so strong that we cannot open them without the aid of a knife or pair of scissors. When cut into we find a lot of pale-brown silky matter, and in the smaller bags part of a chrysalis shell, but in each of the larger ones a great mass of soft yellow eggs.

If the bags are allowed to remain on the tree until late in the spring, there will hatch from these eggs many tiny dark caterpillars, which walk only on the six horny front legs and hold the hind body straight up into the air.

The first thing each little caterpillar does is to begin cutting out little bits of the leaf, or whatever substance it finds itself upon, and weaving these into a band with silk. The ends of this are attached to some plain surface, and the young larva crawls under it and, loosening the fastenings, contrives to join the band around its body for a protection to the soft, thin-skinned portion. By twisting its head back and forth when spinning it contrives to add

something every day to the length of this case, which at first is carried in an erect position, but soon becomes so heavy that it is simply dragged along as the larva crawls about, which it does not do more than is necessary. The latter continues to grow for two months or more, during

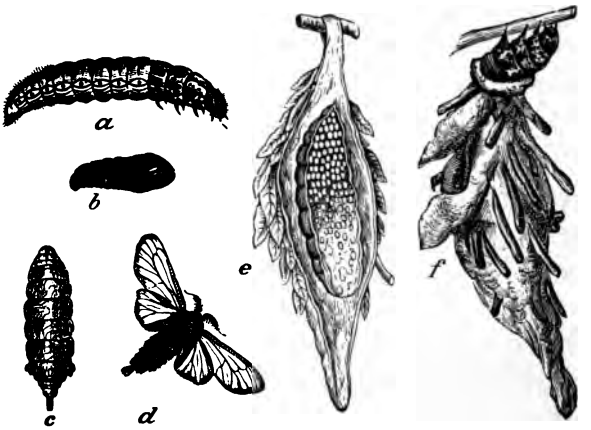


FIG. 34.—The Bagworm, or Basket Worm: *a*, larva; *b*, pupa; *c*, female moth; *d*, male moth; *e*, eggs inside of pupa skin; *f*, larva with case.

which period it moults four times. When these times come it attaches its case firmly to some support and shuts itself up inside, and when the old skin is shed it is pushed out through the opening at the hinder end of the bag. It then pushes its head and first three joints through the covering in front and begins feeding again with a great appetite.

At the end of July or early in August it is full-grown and ceases to feed and becomes unusually active. It is

now a great nuisance, as it has the habit not only of crawling about in every direction, but of swinging down from the tree upon people or animals that may be passing underneath, and so getting a free ride to other localities. Ladies and children are often much startled and disgusted to find clinging to their hats or outer garments one or more of these ugly worms clumsily dragging along their heavy bags. Of course they are instantly pulled or shaken off, and probably tossed to as great distance as possible, and nothing could suit the convenience of the insect better, since at this time the great object of its life is to get a long way off from the tree or bush on which it grew up. You will, perhaps, wonder why; but as the later history of the insect is learned the reason will be plain.

After two or three days of roaming about, the bagworm crawls up into the nearest tree and prepares for its changes of form. It first attaches its case by a broad band of silk to some firm support — never to a leaf stalk or any part that is likely to drop or be blown away. It then retires wholly within it and closes the opening.

Here it soon changes to a pupa, which rests in a soft bed of the downy material already described. Two or three weeks afterwards the last change takes place, and then it is discovered that the males and females are entirely different.

The former is a very active little black moth with slender body and very strong wings. He buzzes and

bustles about with so much energy that in a few hours he rubs all the feathery coating from his wings and body and looks more like a bee than a moth. As for the female, she is a poor, helpless creature, without wings or legs or much of a head. She never leaves the shelter of her bag, which in course of time she almost fills with eggs, and shortly after dies, the small remains of her body serving to plug up the lower opening of her case for the better protection of the eggs.

As the females are in the perfect state so incapable of changing their location, the instinct of the caterpillars for removing from one situation to another can be well understood, since one brood after another would soon eat up all the leaves on one tree or set of trees.

ADVERTISEMENTS

NATURE STUDY

BOOKS OF SPECIAL VALUE

Stories of Insect Life. (First Series.)

By CLARENCE MOORES WEED, Professor of Zoölogy and Entomology in the New Hampshire College of Agriculture and the Mechanic Arts. 12mo. Boards. 54 pages. Illustrated. For introduction, 25 cents.

The insects treated of in this book are the more interesting common forms of spring and early summer. The story of the life of each is told in a simple way, rendering the book especially desirable for children to read in connection with nature studies of insects.

Stories of Insect Life. (Second Series.)

Summer and Autumn. By MARY E. MURTFELDT and CLARENCE M. WEED. 12mo. Cloth. 72 pages. For introduction, 30 cents.

This book, like its predecessor, aims to give to young pupils an accurate and readable account of the life histories of some common insects. It is designed for use during the autumn months, as the first book was especially intended for use in spring. The paragraphs are short, the language simple, with no more technical words than are absolutely necessary, and each story is compressed into a space that will not weary the child. Throughout the stories the reader is incited to make original observations out of doors. An introductory chapter gives suggestions to the teacher regarding methods of using insects in nature study.

Seed-Travellers.

By CLARENCE M. WEED. 12mo. Boards. 53 pages. Illustrated. For introduction, 25 cents.

This book consists of a series of simple discussions of the more important methods by which seeds are dispersed.

It is designed especially for use during autumn and winter. It is believed that the book will prove of decided value in the practical work of the schoolroom.

GINN & COMPANY, Publishers,

Boston. New York. Chicago. Atlanta. Dallas.

STUDY AND STORY NATURE READERS

By J. H. STICKNEY,
Author of the Stickney Readers.

EARTH AND SKY. No. I. A First Grade Nature Reader and Text-Book. Sq. 12mo. Cloth. 115 pages. Fully illustrated. 30 cents.

EARTH AND SKY. No. II. [*In preparation.*

PETS AND COMPANIONS. A Second Reader. Sq. 12mo. Boards. 142 pages. Fully illustrated. 30 cents.

BIRD WORLD. A Bird Book for Children. **With color pictures.** By J. H. STICKNEY, assisted by RALPH HOFFMANN. Sq. 12mo. Cloth. 214 pages. Illustrated. 60 cents.

SEED AND HARVEST. By S. E. BRASSIL and J. H. STICKNEY. [*In preparation.*

The **Study and Story Nature Readers** are readers in form and appearance, but have a wider aim in being well-chosen points of departure through conversational lessons — *opportunities* for observational work.

Earth and Sky, No. I, the first book of the series in grade, is a little reader which embraces a wide range of topics.

Pets and Companions, the second book of the series in grade, is a little reader of stories and easy studies. Its subjects are such familiar animals as are best calculated to inspire sympathy and affection.

No effort has been spared to make **Bird World** one of the most attractive and instructive reading books on birds ever published. Miss Stickney has had associated with her in its literary and artistic preparation Mr. Hoffmann, a gentleman who has lived closer to bird world than any of us. For years he has known by sight and sound all the New England birds and many, if not most, of our chance summer and winter visitors. A number of the stories are based upon his own personal observations. Special features of the book consist of true pictures of birds by the well-known artist, Mr. Ernest S. Thompson, and also of a series of color photographs.

GINN & COMPANY, Publishers.

Boston. *New York.* Chicago. Atlanta. Dallas.

NATURE STUDY

THE JANE ANDREWS BOOKS.

The Seven Little Sisters. With new full-page illustrations. For introduction, 50 cents.

Each and All. With new full-page illustrations. For introduction, 50 cents.

Stories Mother Nature Told her Children. With new full-page illustrations. For introduction, 50 cents.

My Four Friends. For introduction, 40 cents.

STICKNEY'S STUDY AND STORY NATURE READERS.

By J. H. STICKNEY, author of the Stickney Readers.

Earth and Sky. For introduction, 30 cents.

Pets and Companions. For introduction, 30 cents.

Bird World. By J. H. STICKNEY, assisted by RALPH HOFFMANN. For introduction, 60 cents.

STRONG'S ALL THE YEAR ROUND.

By FRANCES L. STRONG of the Teachers' Training School, St. Paul, Minn.

Part I., Autumn. Part II., Winter. Part III., Spring. Each, for introduction, 30 cents.

EDDY'S FRIENDS AND HELPERS.

Compiled by SARAH J. EDDY. For introduction, 60 cents.

GOULD'S MOTHER NATURE'S CHILDREN.

By ALLEN WALTON GOULD. For introduction, 60 cents.

LANE'S ORIOLE STORIES.

By M. A. L. LANE. For introduction, 28 cents.

LONG'S WAYS OF WOOD FOLK. (First Series.)

By WILLIAM J. LONG. For introduction, 50 cents.

LONG'S WILDERNESS WAYS. (Second Series.)

By WILLIAM J. LONG. For introduction, 45 cents.

MORLEY'S LITTLE WANDERERS.

By MARGARET WARNER MORLEY. For introduction, 30 cents.

WEED'S STORIES OF INSECT LIFE. (First Series.)

By CLARENCE M. WEED, Professor of Zoölogy and Entomology in the New Hampshire College of Agriculture and the Mechanic Arts. For introduction, 25 cents.

MURTFELDT AND WEED'S STORIES OF INSECT LIFE. (Second Series.)

By MARY E. MURTFELDT and CLARENCE MOORES WEED. For introduction, 30 cents.

WEED'S SEED-TRAVELLERS.

By CLARENCE M. WEED. For introduction, 25 cents.

BEAL'S SEED DISPERSAL.

By W. J. BEAL, Professor of Botany and Forestry in Michigan State Agricultural College. For introduction, 35 cents.

BURT'S LITTLE NATURE STUDIES FOR LITTLE PEOPLE.

From the Essays of JOHN BURROUGHS. Edited by MARY E. BURT.

Volume I. A Primer and a First Reader. Volume II. A Second Reader and a Third Reader. Each, for introduction, 25 cents.

BERGEN'S GLIMPSES AT THE PLANT WORLD.

By FANNY D. BERGEN. For introduction, 50 cents.

HALE'S LITTLE FLOWER PEOPLE.

By GERTRUDE ELISABETH HALE. For introduction, 40 cents.

GINN & COMPANY, Publishers,

Boston. New York. Chicago. San Francisco.
Atlanta. Dallas. Columbus. London.

ALL THE YEAR ROUND.

By FRANCES L. STRONG,

Of the Teachers' Training School, St. Paul, Minn.

Part I. AUTUMN.

8q. 12mo. 102 pages. Fully illustrated. For introduction, 30 cents.

Part II. WINTER.

8q. 12mo. Cloth. 102 pages Fully illustrated. For introduction, 30 cents.

Part III. SPRING.

8q. 12mo. Cloth. 99 pages. Fully illustrated. For introduction, 30 cents.

THIS series is designed to tell in a child's language, and in a manner interesting to children, stories of the natural object studied for a specific day or lesson. The stories correspond in order of arrangement as nearly as possible to the precise time of the year at which the materials may be most readily obtained in our latitude.

The work is adapted to the second, third, or fourth year of school according to the course of study in the schools which use it.

The stories are illustrated by Gertrude A. Stoker, Supervisor of Drawing in the St. Paul Public Schools, with pen-and-ink sketches of the objects studied.

The series also contains literary selections akin to the lessons, and references to selections of similar nature that may be obtained from other sources.

GINN & COMPANY, PUBLISHERS,

BOSTON. NEW YORK. CHICAGO. ATLANTA.

THE FINCH READERS

By ADELAIDE V. FINCH,
Principal of Training School for Teachers, Waterbury, Conn.

THE FINCH PRIMER. Square 12mo. Boards. 90 pages. Fully illustrated. With colored pictures. For introduction, 30 cents.

THIS is a genuine nature primer adapted to the youngest readers. The lessons are upon leaves, flowers, fruits, birds, animals, the snow, and the simplest things in nature arranged according to the seasons.

The lessons, until after the holidays, are in engraved vertical script; then for a few pages both script and print are given. The remainder of the book is in print. There are three hundred new words. Each word is repeated as many times as is consistent and necessary without sacrificing literature to repetition.

It contains a number of colored plates and forms altogether one of the most beautiful and suggestive primers ever published.

THE FINCH FIRST READER. Square 12mo. Cloth. 145 pages. Illustrated. With colored pictures. For introduction, 30 cents.

FOLLOWING the plan outlined in the Primer, the "Finch First Reader" presents carefully graded lessons appropriate to the seasons of the year. The varied interests of child life are pictured by stories about children, animals, plants, great men whom children can be taught to love and appreciate, typical industries, as harvesting in the fall, ice-cutting in the winter, and planting in the spring.

Words from the vocabulary of the Finch Primer have been freely used, with nearly five hundred additional words. This reader presents an unusually large amount of reading matter, and it may follow or be used in connection with the Finch Primer or any other primer of the same grade.

GINN & COMPANY, Publishers,

Boston.	**New York.**	**Chicago.**	**San Francisco.**
Atlanta.	**Dallas.**	**Columbus.**	**London.**

CYR'S READERS

By ELLEN M. CYR.

CYR'S PRIMER. Square 12mo. Cloth. 106 pages. Fully illustrated Price, 24 cents.

CYR'S FIRST READER. Square 12mo. Cloth. 111 pages. Fully illustrated. Price, 28 cents.

CYR'S SECOND READER. Square 12mo. Cloth. 197 pages. Fully illustrated. Price, 36 cents.

CYR'S THIRD READER. Square 12mo. Cloth. 280 pages. Fully illustrated. Price, 50 cents.

CYR'S FOURTH READER. Square 12mo. Cloth. 388 pages. Fully illustrated. Price, 60 cents.

CYR'S FIFTH READER. Square 12mo. Cloth. 428 pages. Fully illustrated. Price, 70 cents.

CYR'S READERS are in harmony with the best educational thought of the time. They make a most excellent introduction to a course of reading made up of whole pieces of the best literature. They do a work for schools for which it would be very difficult to find a substitute. The children take a constant delight in using them. They arouse at once such an interest in reading that the teaching to read is half accomplished. Children learn to read from these books in less than half the time than from ordinary readers.

A series of school readers that can arouse and maintain an interest on the part of pupils for what is wholesome and elevating in literature must necessarily be the rarest of all among books for schools. The Cyr books are of this remarkable sort. They possess a peculiar quality of interest and inspiration. They not only interest but stimulate young people. This is the secret of their exceptional success. This is the reason why teachers like to teach them and young folks like to read them.

GINN & COMPANY, Publishers,

Boston. *New York.* Chicago. Atlanta. Dallas.